STAT303 Sec 508-510
Spring 2008
Exam #3
Form A

Instructor: Julie Hagen Carroll

Name:______________________________

1. **Don't even open this until you are told to do so.**
2. There are 20 multiple-choice questions on this exam, each worth 5 points. There is partial credit. Please mark your answers **clearly**. Multiple marks will be counted wrong.
3. You will have 60 minutes to finish this exam.
4. If you have questions, please write out what you are thinking on the back of the page so that we can discuss it after I return it to you.
5. If you are caught cheating or helping someone to cheat on this exam, you both will receive a grade of **zero** on the exam. You must work alone.
6. When you are finished please make sure you have marked your CORRECT section (Tuesday 12:45 is 508, 2:20 is 509, and 3:55 is 510) and FORM and 20 answers, then turn in JUST your scantron.
7. Good luck!

1. A new method for measuring phosphorus levels in soil is described in a journal article. A sample of 11 soil specimens, each with a true phosphorus content of 548 mg/kg is analyzed with the new method. Based on the samples, we want to determine if the mean phosphorus level reported by the new method is significantly different from the true value of 548. What hypotheses should we test? Let μ_{new} be the true mean value of using the new method and μ_{old} be the true mean value using the previous method.

   A. $H_0 : \mu_{new} = \mu_{old}$ vs. $H_A : \mu_{new} \neq \mu_{old}$
   B. $H_0 : \pi_{new} = \pi_{old}$ vs. $H_A : \pi_{new} \neq \pi_{old}$
   C. $H_0 : \mu = 548$ vs. $H_A : \mu \neq 548$
   D. $H_0 : \mu = 548$ vs. $H_A : \mu < 548$
   E. $H_0 : \mu_{new} = \mu_{old}$ vs. $H_A : \mu_{new} < \mu_{old}$

2. Which of the following would be an example of a Type II error in the test above?

   A. failing to prove the new method produces a different mean value when it's actually a better method
   B. claiming that the old method is better when the new method is actually better
   C. failing to prove that the new method reports a different value when in fact it does have a different mean value
   D. claiming that the new method reports a different mean when it actually reports the same mean value
   E. reporting that the means are equal when they really are not

3. Using the three confidence intervals below, what is the correct range of the p-value when testing $H_0 : \mu = 4$ vs. $H_A : \mu \neq 4$?

```
90% (4.01057, 7.58943)
95% (3.61245, 7.98754)
99% (2.73322, 8.86678)
```

   A. p-value > 0.10
   B. $0.10 >$ p-value > 0.05
   C. $0.05 >$ p-value > 0.01
   D. p-value< 0.01, because 0 isn't in any of the intervals
   E. You need a test statistic value to determine the p-value

4. Which of the following *best* describes the p-value in a test of hypotheses?

   A. The p-value is a test statistic used to determine whether H_0 should be rejected or not.
   B. The p-value is the probability, assuming that H_0 is true, that any sample data would be at least as extreme as that observed.
   C. The p-value is the probability calculated from the data that H_0 is true.
   D. The p-value is the probability calculated from the data that H_0 is rejected.
   E. The p-value is the probability calculated from the data that the hypothesized value would fall in a $(1 - \alpha) * 100\%$ confidence interval.

5. Suppose I need to know whether the true test score is under 70, so I want to test $H_0 : \mu = 70$ vs. $H_A : \mu < 70$. If I sample the population 20 times and reject (conclude the true mean is under 70) twice (2 out of 20 times), what does this tell me?

   A. The true mean really is under 70 since I rejected twice.
   B. The true mean is probably not under 70. The 2 out 20 rejections, 10%, is just my sample estimate of α, the chance of making a Type I error.
   C. The true mean is probably not under 70. The 2 out 20 rejections, 10%, is just my sample estimate of β, the chance of making a Type II error.
   D. The true mean is under 70. The 2 out 20 rejections, 10%, is just my sample estimate of α, the chance of making a Type I error.
   E. The true mean is under 70. The 2 out 20 rejections, 10%, is just my sample estimate of β, the chance of making a Type II error.

6. A manufacturer receives parts from two suppliers. A SRS of 400 parts from supplier 1 finds 20 defective, and a SRS of 100 parts from supplier 2 finds only 10 defective. Rather than running a hypothesis test, we calculated a 90, 95 and 99% confidence for the difference in the true proportion of defectives for the two suppliers, $\pi_1 - \pi_2$: $(-0.103, 0.003), (-0.113, 0.013), (-0.133, 0.033)$. What conclusion could we make?

   A. Since 0 is in all three confidence intervals, it is plausible that the true proportion of defectives is the same for the two suppliers.
   B. Since 0 is in all three confidence intervals, it is plausible that the true proportion of defectives is different for the two suppliers.
   C. Since 0.05 isn't in any of the confidence intervals, we would conclude that the true proportion of defectives is different for the two suppliers.
   D. Since 0.01 is in the 95 and 99% confidence interval, it is plausible at the 1% level that the true proportion of defectives is the same for the two suppliers.
   E. Since we don't have a p-value, we can't come up with a conclusion.

7. In the previous problem, the sample proportions were $20/400 = 0.05$ and $10/100 = 0.10$ for supplier 1 and 2 respectively. If supplier 2 had 20 defectives instead of only 10, what would have been the difference?

    A. It would have been less likely that the two true proportion of defectives were the same.
    B. It would have been more likely that the two true proportion of defectives were the same.
    C. It would not have made any difference since we're testing the true proportions and not the sample proportions.
    D. We would have to run another test, or calculate new intervals to tell.
    E. None of the above are correct.

8. Which of the following is always a necessary assumption in test of hypotheses?

    A. the data must follow a normal distribution
    B. the data must be from a random sample
    C. the true standard deviation must be known
    D. All of the above are always necessary.
    E. Only two of the above are always necessary.

9. Remember our last men's basketball game? Let's make that last foul a hypothesis test. The null would be that no foul occurred and the alternative would be that a foul did occur. If we reject, then we get to make a free throw; otherwise we don't get to try. Being that our guy really was fouled according to later game footage but they didn't call it, what happened?

    A. a Type I error
    B. a Type II error
    C. a correct decision
    D. who knows
    E. It was just a sad state of affairs.

10. Researchers wish to determine whether the level of C reactive protein in the blood of children in Papua, NewGuinea is different from the known average for the general population of children, $\mu = 2.8$ with $\sigma = 1.2$. A sample of 40 children in Papua had an average of 3.2 with standard deviation 1.4. It is known, however, that the true standard deviation for the children in New Guinea is the same as the general population of children. What type test should the researchers use to test their hypothesis?

    A. a 2-sample t-test
    B. a pooled t-test since the standard deviations are the same
    C. a paired t-test
    D. a 1-sample t-test
    E. a 1-sample z-test

11. What is the range of the p-value for testing $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 \neq \mu_2$ if $\bar{x}_1 = 12.2$, $s_1 = 9.3$, $n_2 = 15$, $\bar{x}_2 = 18.6$, $s_2 = 7.1$, $n_2 = 18$ and the test statistic is 2.241?

    A. $0.02 > p\text{-value} > 0.01$
    B. $0.04 > p\text{-value} > 0.02$
    C. $0.025 > p\text{-value} > 0.02$
    D. $0.05 > p\text{-value} > 0.04$
    E. $p\text{-value} > 0.025$

12. Are distance runners really lighter (less heavy) than other athletes? Suppose we took a random sample of 50 male distance runners and another random sample of 50 male weight lifters and compared their average weights. Which type of hypothesis test should we use?

    A. a one sample t-test since we'd have to use the sample standard deviation
    B. a two sample t-test, but only if we know the data is normal
    C. a pooled t-test since we know the sample means would be approximately normal
    D. a two sample t-test since we know the sample means would be approximately normal
    E. a paired t-test since we have the same sample sizes

13. If our test resulted in a p-value of 0.023, which of the following would be the best conclusion we could make?

    A. At the 5% level, we would conclude that distance runners are indeed lighter than all other athletes.
    B. At the 5% level, we would conclude that distance runners are lighter than weight lifters.
    C. At the 5% level, we could not conclude that distance runners are lighter than weight lifters.
    D. At the 5% level, we could not conclude that distance runners are indeed lighter than all other athletes.
    E. We would need a confidence interval for the true difference of their average weights to decide.

14. In the past, it was believed that 40% of women felt that 'men are basically selfish and self-centered'. It is now claimed that this proportion has increased. A sample of 3000 women shows that 1260 agree with this statement. Which hypotheses should be used to test the new claim?

    A. $H_0 : \pi \leq 0.4$ vs. $H_A : \pi > 0.4$
    B. $H_0 : \pi \leq 1260/3000$ vs. $H_A : \pi > 1260/3000$
    C. $H_0 : \pi \geq 0.4$ vs. $H_A : \pi < 0.4$
    D. $H_0 : \mu \leq 0.4$ vs. $H_A : \mu > 0.4$
    E. Both A and B will work.

15. Suppose the p-value for testing $H_0 : \pi_1 = \pi_2$ vs. $H_A : \pi_1 \neq \pi_2$ is 0.12. Which of the following is true?

    A. There is a 12% probability that H_0 is true (H_A is false).
    B. There is a 12% probability of obtaining a difference between p_1 and p_2 smaller than this one if π_1 and π_2 are really equal.
    C. There is a 12% probability of obtaining a difference between p_1 and p_2 smaller than this one if π_1 and π_2 are really different.
    D. There is a 12% probability of obtaining a difference between p_1 and p_2 at least as big as this one if π_1 and π_2 are really equal.
    E. There is a 12% probability of obtaining a difference between p_1 and p_2 at least as big as this one if π_1 and π_2 are really different.

16. Many people say that dentists make them nervous. One way to determine whether someone is stressed, *e.g.*, from having to go to the dentist, is to measure their blood pressure. So, we want to know if visiting the dentist causes the mean blood pressure to increase. What would be the consequence of a Type I error?

    A. concluding that people's blood pressure increases when they visit the dentist when it actually doesn't
    B. concluding that people's blood pressure increases when they visit the dentist when it actually does
    C. concluding that people's blood pressure decreases when they visit the dentist when it actually doesn't
    D. concluding that people's blood pressure decreases when they visit the dentist when it actually does
    E. concluding that people's blood pressure doesn't increase when they visit the dentist when it actually does

17. Using the three confidence intervals below, what is the correct range of the p-value when testing $H_0 : \pi_1 = \pi_2$ vs. $H_A : \pi_1 \neq \pi_2$?

```
90% (0.1412, 0.3588)
95% (0.1204, 0.3796)
99% (0.0796, 0.4204)
```

    A. p-value > 0.10
    B. $0.10 >$ p-value > 0.05
    C. $0.05 >$ p-value > 0.01
    D. p-value< 0.01
    E. There's not a hypothesized value to determine the p-value.

18. If I test $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 \neq \mu_2$, and get a p-value $= 0.02$, which of the following would be true?

    A. I would conclude the means are different at the 5 and 10% significance levels, but not at the 1%.
    B. 0 would be in a 99% confidence interval for the difference of the true means, but 0 would not be in either the 90 or 95% intervals.
    C. I must have both sample sizes greater than 30 if I don't know the data is normal.
    D. All of the above are true.
    E. Exactly two of the above are true.

19. What is the p-value for testing $H_0 : \pi = 0.5$ vs. $H_A : \pi < 0.5$ if the sample proportion, $p = 0.64$ with $n = 25$?

    A. We can't do a z-test since the sample size is less than 30.
    B. $0.10 >$ p-value > 0.05
    C. $0.20 >$ p-value > 0.10
    D. 0.0808
    E. 0.9192

20. A public health worker suspects that pipes in one of the older A&M dorms is causing students living there to have excess lead in their blood, *i.e.*, over 100ppb (parts per billion). Twenty randomly selected residents of the dorm had their levels checked. The mean and standard deviation were 110 and 25, respectively. The public worker calculated a 95% confidence interval for the true mean from the data and got (98.32,121.68). Which of the following is the best interpretation of this interval?

    A. About 95% of the students in the dorm have lead blood levels between 98.32 and 121.68.
    B. About 95% of the time a student's lead blood level will be between 98.32 and 121.68.
    C. If the worker took repeated samples of the students in the suspect dorm, about 95% of these samples would have mean lead blood levels between 98.32 and 121.68.
    D. If the worker took repeated samples of the students in the suspect dorm, about 95% of the intervals from these samples would contain the true mean lead blood level for this dorm.
    E. If the worker took repeated samples of the students in the suspect dorm, about 95% of the intervals from these samples would contain the true mean lead blood level for all of the dorms.

1C,2C,3B,4B,5B,6A,7A,8B,9B,10E,11B,12D
13B,14A,15D,16A,17D,18D,19E,20D